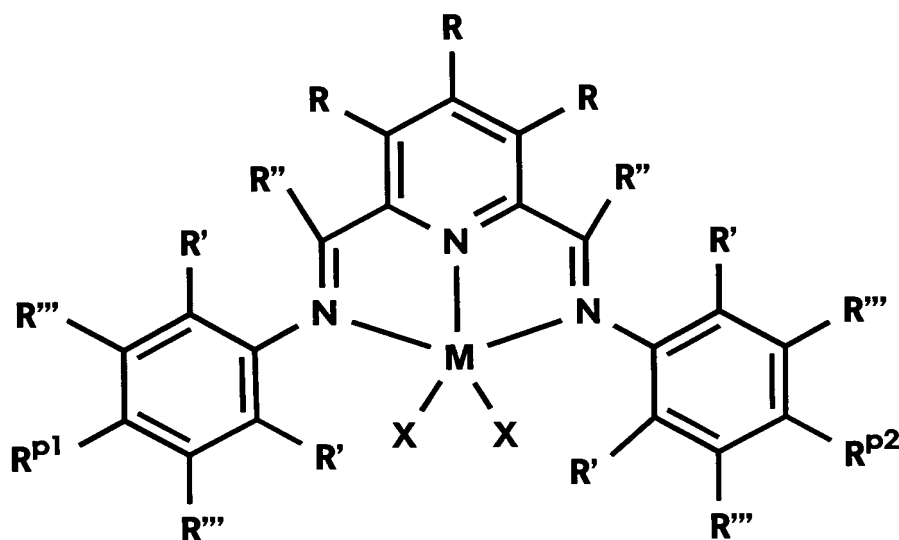


Claims

What is claimed is:

1. A composition comprising the product of combining, in the presence of a free radical initiator a catalyst precursor and at least one monomer wherein the monomer and the catalyst precursor are polymerizable by free-radical polymerization and wherein the catalyst precursor compound is represented by the formula:



wherein

- (a) each X is an abstractable ligand;
- (b) Each R, R', R'', R''', R^{p1} and R^{p2} are independently selected from hydrogen or a hydrocarbyl group provided at least one of R^{p1}, R^{p2}, or R''' can be polymerized by a free radical initiator;
- (c) M is a Group-4-11 metal.

2. The composition of claim 1 wherein each R, R', R'', R''', R^{p1} and R^{p2} are independently selected from hydrogen or a C₁-C₅₀ hydrocarbyl group.
3. The composition of claim 2 wherein
- 5 (a) Each R' is independently one of hydrogen, methyl, ethyl, propyl, butyl, cyclohexyl, phenyl; and
- (b) R_{p1} and R_{p2} are independently selected from hydrogen, methyl, ethyl, propyl, butyl, cyclohexyl, phenyl, vinyl, allyl, or ω -olefin provided that at least one of R_{p1} and R_{p2} can be polymerized by a free radical initiator.
- 10
4. The composition of claim 2 wherein
- (a) Each R is independently one of hydrogen, allyl, methyl, or phenyl groups;
- (b) Each R'' is independently one of hydrogen, methyl, or phenyl groups;
- 15
- (c) Each R''' is independently one of hydrogen, methyl, isopropyl, tertiary butyl, or phenyl.
5. The composition of claim 4 wherein
- (a) Each R is independently one of hydrogen, allyl, methyl, or phenyl groups;
- 20
- (b) Each R'' is independently one of hydrogen, methyl, or phenyl groups;
- (c) Each R''' is independently one of hydrogen, methyl, isopropyl, tertiary butyl, or phenyl.

6. The composition of claim 3 wherein M is selected from a Group-8-9 transition metal.
7. The composition of claim 6 wherein M is selected from Fe or Co.
8. The composition of claim 3 wherein the abstractable ligands are
5 independently hydride radicals; hydrocarbyl radicals; hydrocarbyl-substituted, organometalloid radicals.
9. The composition of claim 8 wherein two abstractable ligands join to form a 3-to-40-atom metallocycle ring.
10. The composition of claim 8 wherein abstractable ligands are
10 independently halogen, alkoxide, aryloxy, amide, or phosphide radicals.
11. The composition of matter of claim 10 wherein abstractable ligands are chloride, bromide, iodide, methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl, tridecyl,
15 tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl, eicosyl, heneicosyl, docosyl, tricosyl, tetracosyl, pentacosyl, hexacosyl, heptacosyl, octacosyl, nonacosyl, triacontyl, hydride, phenyl, benzyl, phenethyl, tolyl, methoxy, ethoxy, propoxy, butoxy, dimethylamino, diethylamino, methylethylamino, phenoxy,
20 benzoxy, allyl, 1,1-dimethyl allyl, 2-carboxymethyl allyl, acetylacetonate, 1,1,1,5,5,5-hexa-fluoroacetylacetonate, 1,1,1-trifluoro-acetylacetonate, or 1,1,1-trifluoro-5,5-dimethylacetylacetonate radicals.
12. The composition of matter of claim 11 wherein at least one
25 abstractable ligand is chloride.

13. The composition of claim 3 wherein the one or more monomers comprise styrene, vinyl styrene, alkyl styrene, isobutylene, isoprene, or butadiene.
14. The composition of claim 13 wherein the one or more monomers
5 comprise styrene.
15. The composition of claim 1 wherein the free radical initiator is selected from azo initiators or peroxides.
16. The composition of claim 3 wherein the free radical initiator is selected from dialkyldiazenes, hyponitrites, diacyl peroxides, dialkyl
10 peroxydicarbonates, peresters, alkyl hydroperoxides, dialkyl peroxides, or inorganic peroxides.
17. The composition of claim 3 wherein the free radical initiator is selected from 2,2'-azobis(2-methylpropanenitrile), 1,1'-azobis(1-cyclohexanenitrile), 4,4'-azobis(4-cyanovaleric acid),
15 triphenylmethyldiazobenzene, di-t-butyl hyponitrite, dicumyl hyponitrite, dibenzoyl peroxide, didodecanoyl peroxide, diacetyl peroxide, diisopropyl ester, dicyclohexyl ester, cumyl hydroperoxide, t-butyl hydroperoxide, dicumyl peroxide, di-t-butyl peroxide, hydrogen peroxide, and persulfate initiators.
- 20 18. A catalyst system comprising the reaction product of the composition of claim 1 and an activator.
19. The catalyst system of claim 18 wherein the activator is selected from alumoxanes, aluminum alkyls, alkyl aluminum halides, alkylaluminum alkoxides, discrete ionic activators, and Lewis acid
25 activators.

20. The catalyst system of claim 19 wherein the activator is selected from methylalumoxane, modified methylalumoxane, ethylalumoxane, trimethyl aluminum, triethyl aluminum, triisopropyl aluminum, diethyl aluminum chloride, alkylaluminum alkoxides, ammonium borate salts, phosphonium borate salts, triphenyl carbenium borate salts, ammonium aluminate salts, phosphonium aluminate salts, triphenyl carbenium aluminate salts, trisarylborane acids, and polyhalogenated heteroborane anions.
21. A method to polymerize olefin comprising contacting an olefin and the composition of any of claims 1-17, a method to polymerize olefin comprising contacting.
22. The catalyst system of any of claims 18, 19 or 20 and an olefin.